Changes occurring in the breed composition of U.S. dairy herds

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Abstract

The breed composition of Dairy Herd Improvement (DHI) herds from 1990-2018 was examined to determine what changes have occurred in the U.S. population. Breed was characterized by the animal's recorded breed code. Animals with breed code 'XX' or 'XD' were considered crossbred. The number of animals obtaining genetic evaluations increased by 66.9% since 1990 even though number of DHI herds declined by 64.2%. This confirms a substantial increase of recorded pedigrees in the national database since 2006. Breed composition was examined on a herd and year of calving basis. Ayrshire (AY), Brown Swiss (BS), Guernsey (GU), Holstein (HO), Jersey (JE), Milking Shorthorn (MS), and 'other breeds' were documented as was crossbred composition. An investigation was conducted to determine total cows assigned to each breed by year. All lactation records entering the database were examined. Trends were substantiated on a cow basis. From 1990 to 2018, the number of cows increased from 2,386,473 to 3,983,909. HO increased from 2,161,579 to 3,243,490; JE increased from 135,374 to 485,849. Crossbreds experienced the greatest percentage increase going from 2,971 to 207,368. Sires and dams of all cows were examined also. HO and JE sires comprised 83.3% and 14.8% of DHI cows in 2018 respectively. The percentage of HO has been gradually decreasing (90.8 to 83.3%) while the percentage of JE has been increasing (5.7 to 14.8%). The parentage of crossbreds was examined to determine the background of the growing crossbred population (5.2% in 2018). Any breeds having representation of ≥0.1% were shown. A majority of dams of crossbreds were coded as crossbreds also (54.6%); 51.3% of the sires of crossbreds were HO. The breed of the maternal grandparents when the dam was a crossbred was assessed also. Similarly, 60.6% of their maternal granddams were crossbreds and 57.7% of their maternal grandsires were HO. The parents and grandparents of XX or XD cows display a significant reduction in the number of currently unknown breed codes. Reporting thresholds for breeds presence in individual herds were 1 cow, 10%, 25%, 50%, 75% and 90%. The number and percentage of herds meeting each threshold within each breed was determined. The number of herds that had at least 75% crossbreds increased from 18 to 189 from 1990 to 2018, while herds with 75% HO declined from 34,977 to 11,604 and those with 75% JE declined from 2,323 to 859.

Key words: breed composition; United States; dairy herds; crossbreds;

Introduction

A few reports have disclosed that the breed composition of the US dairy population has been changing over the last two decades. This is revealed in the shift in U.S. domestic semen sales over the same period (NAAB website/ https://www.naab-css.org/file.aspx?id=c775900a-f0a7-40c1-85eb-ad541651ed20). Changes came for various reasons including 1) shifting demand for dairy products; 2) renewed interest in different traits; 3) promotion of breeds with limited U.S. presence; and 4) the desire to capitalize on heterosis. The consequence is that more U.S. animals have multi-breed genetics.

Labeling of crossbreds has not been done uniformly and therefore does not reveal the entire genetic background. Some animals having multi-breed composition (especially those with a predominant breed) are recorded like those truly of a single breed. Thus, examining breed codes of the sire and dam of animals and (in specific cases) of their grandparents should reveal more about the actual breed composition of either "apparent purebred" or crossbred cows. Recent use of semen from European breeds such as Norwegian Red (NR), Swedish Red & White (SR), Montbeliarde (MO) and Normandy (NO) have produced multi-breed cattle labeled like a single breed. Documentation of possible expansion of these breeds has been limited.

There is considerable interest from various industry organizations in knowing the genetic background of the US dairy population, particularly the breed makeup of individual herds. A thorough examination is necessary to provide accurate predictions for performance traits. Milk component percentages have increased due to shifts in breed populations over the last decade. Results revealing herd composition of each breed across time are also inadequate.

Material and Methods

In order to document the changes in breed and resulting herd composition across time (1990 to 2018), four separate examinations were completed. First, percentages of cows were determined by their recorded breed codes. Second, the breed codes of sires and dams of cows coded as apparent purebreds (i.e., with a single breed code) were examined because some cows recorded the same as purebreds actually have multi-breed composition. Third, breed codes of the sires and dams of cows coded as crossbred were summarized to reveal more about their genetic makeup. If their dams were coded as crossbred also, the breeds of their maternal grand-dams were summarized. Fourth, herds were stratified by thresholds, showing the percentage of herds that had at least 1 cow, 10%, 25%, 50%, 75%, and 90% of individual breeds across time.

Results & Discussion

I. Number and percentage of cows having each breed code

Table 1 illustrates the decrease in the number of herds in the U.S. while simultaneously highlighting the growing number of cows with sire I.D.

Table 1. Change in total number of cows and herds in the DHI national database.

	1990	2018	Difference
Total no. of cows	2,386,473	3,983,909	66.9%
Total no. of herds	40,196	14,403	-64.2%

Table 2 shows the change in the number of cows by breed in 1990, 2013 and 2018.

Table 2. Number of DHI cows by breed frequency in selective years.

	1990	2013	2018
Ayrshire	16,803	9,167	6,487
Brown Swiss	25,954	25,319	20,786
Dutch Belted	0	693	1,215
Guernsey	32,375	7,449	6,169
Holstein	2,161,579	3,402,735	3,243,490
Jersey	135,374	367,830	485,849
Jamaica Hope	0	0	14
American Lineback	0	655	656
Milking Devon	0	9	0
Meuse-Rhine-Yssel	0	0	2
Montbeliarde	0	1,721	533
Milking Shorthorn	3,698	4,917	3,688
Normande	0	256	207
Norwegian Red	0	212	2,825
Red Dane	4	172	80
European Red Dairy	0	37	93
Red Poll	4	101	73
Simmental/Fleckvieh	0	1,002	1,657
Swedish Red & White	0	483	294
Red and White	7,711	4,193	2,423
Crossbred	2,971	146,262	207,368

The percentage of cows with breed code HO (Figure 1) declined from 90.6% in 1990 to 81.4% in 2018. Some of this decline resulted from JE increasing from 5.7 to 12.2% and crossbreds (Figure 2) increasing from 0.1 to 5.3%. The crossbred and JE cows replaced some of the other traditional breeds like AY, BS and GU as well. The AY, BS, GU MS and Red and Whites (WW) represented 0.7, 1.1, 1.4, 0.2 and 0.3% of the cows in 1990 (respectively), but these declined to 0.2, 0.5, 0.2, 0.1 and 0.1% in 2018. Aside from these, NR was the only other breed that reached 0.1% and it was only for the most recent year. Table 2 also reveals an increase in the number of NR cows.

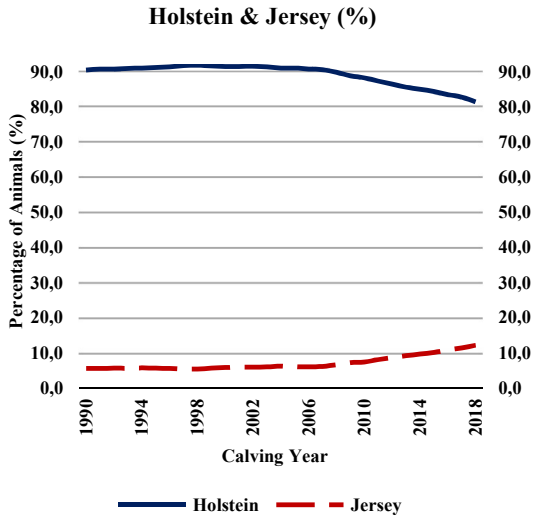

Figure 1. Percentage of DHI cows assigned a Holstein or Jersey breed code.

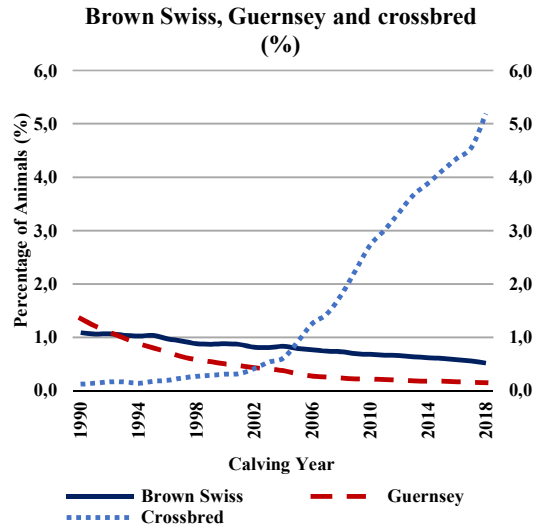

Figure 2. Percentage of DHI cows assigned a Brown Swiss, Guernsey or crossbred breed code.

II. Breed frequency of sire and dam of DHI cows recorded as purebreds

Several breed associations have grading-up programs that allow animals that are not enrolled as registered animals to enter the herd book and obtain provisional registration. In other cases, they even permit animals having genetics of another breed to enter the path to full registration. Thus, it is advantageous to show how genes from other breeds have been transferred. Figure 3 shows both the sires and dams of HO cows are nearly always from the HO breed while sires of most other breeds are often 95 to 98% of the same breed as the cow. Percentage of dams having the same breed code are usually slightly higher than the sires with the same breed. One exception is for JE where the dams are slightly lower than the sires meaning JE bulls are being mated to other breeds. Another exception is for NR where their bulls were nearly always mated to a different breed as there were few NR cows in U.S. herds. In contrast, WW and crossbred cows are nearly always mated to a bull with a different breed code.

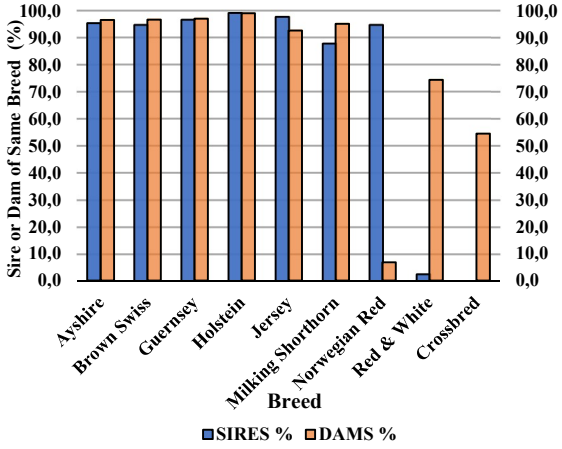

Figure 3. Sires or dams recorded with the same breed as the cow.

III. Breed frequency of sire and dam of DHI cows recorded as crossbreds

Figure 4 provides insight into the genetics of the crossbred cows from their paternal side. In 1990, HO and JE sires together accounted for 66% of the breed codes of their sires (43% and 23%, individually respectively). In 1998, HO provided 58% and JE 22%. Over the next 12 years, there was a clear shift as JE sires became more prevalent. By 2010 JE accounted for 43% of their sires, and the HO had declined to 30%. Following that, the trend was reversed again, so in 2018 HO and JE accounted for 51% and 34%. All other breeds made up 34% of sire breed codes in 1990, but currently account for only 13%. In 1990, BS, GU and AY were the sires of 16.4, 7.3 and 4.7% of milking crossbreds. In 2018, MO (4.0%) SR (2.8%) and NR (2.7%) accounted for the remaining sire breed coding.

Figure 5 shows the genetics of crossbreds coming from the maternal side. For the last 29 years, the breeds recorded for the dams of crossbreds have been primarily HO or crossbreds (also), together accounting for 77 to 94% of those recorded. A number of other breeds accounted for the remainder in 1990 (GU, 7.9%; BS, 7.1%). Jerseys have become an origin of the dams for milking crossbreds, but only in the last few years (18% in 2018).

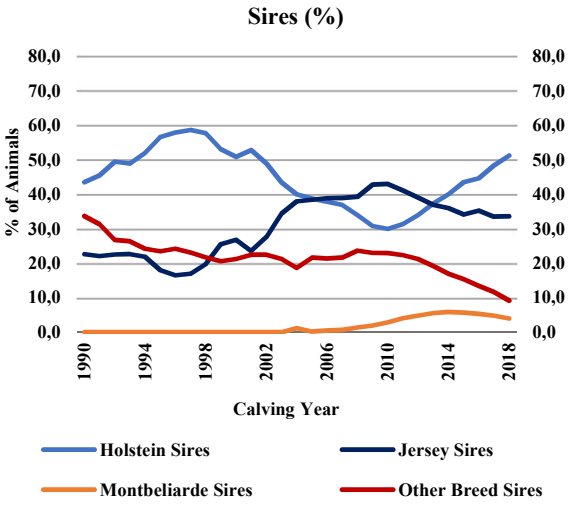

Figure 4. Breed frequency of sires of DHI cows recorded as crossbreds.

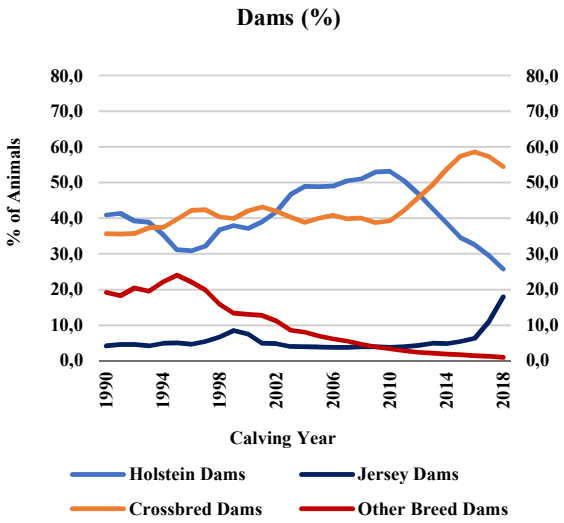

Figure 5. Breed frequency of dams of DHI cows recorded as crossbreds.

IV. Percentage of herds having cows of individual breeds

The following figures show the various breed compositions in percentages for individual herds: Figure 6 (AY), Figure 7 (GU), Figure 8 (MS), Figure 9 (HO), Figure 10 (JE), Figure 11 (crossbreds), Figure 12 (BS) and Figure 13 (*All other breeds*). It is increasingly common to see more breeds (albeit not in large percentages) represented in a typical U.S. herd. Herds having at least one crossbred cow increased from 2.8 to 35.5% over the 29-year period. Three other breeds (AY, HO and MS) increased by near 3 percentage points, while GU declined slightly. The other breeds (Figure 13) were primarily WW and American Linebacks.

The picture differed for those herds having at least 25% of individual breeds, and was much more consistent over time. Crossbreds and JE increased by 5.4 and 2.3 percentage points, respectively. AY, GU and all other breeds had a lower percentage of herds having 25% of their cows of their specific breed while BS, HO and MS showed little change from 1990 to 2018. Herds having over 75% of their individuals of a single breed changed even less than for the 25% level with the exception of HO which declined from 87.0% to 80.6% and GU dropping from 1.9% to 0.6%. AY, BS and MS also showed declines while crossbreds and JE each increased slightly (1.3 and 0.2%).

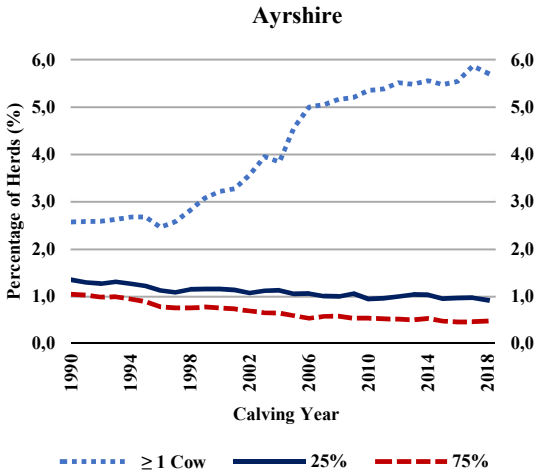

Figure 6. Percentage of herds with cows coded as Ayrshire.

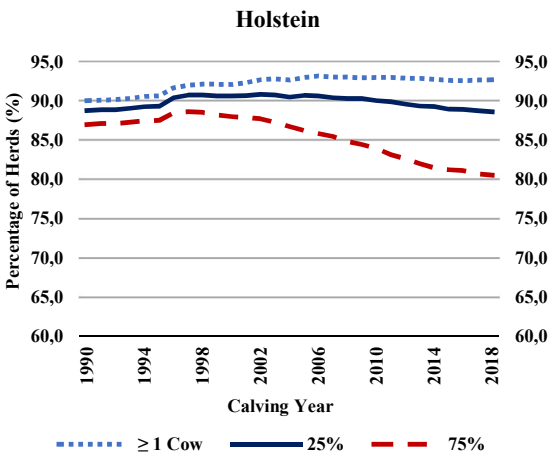

Figure 9. Percentage of herds with cows coded as Holstein.

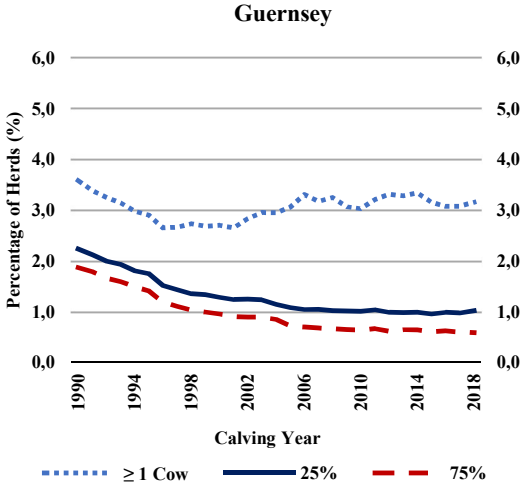

Figure 7. Percentage of herds with cows coded as Guernsey.

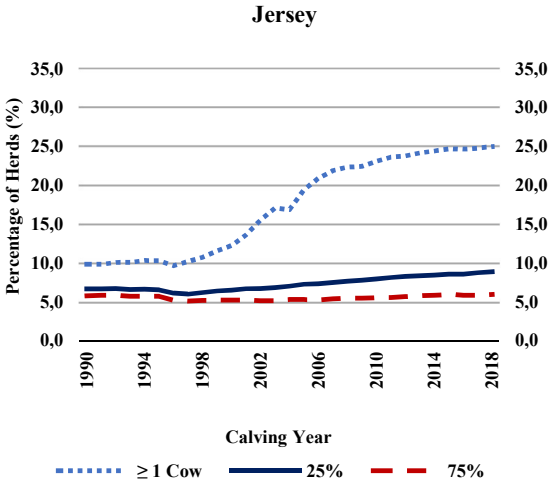

Figure 10. Percentage of herds with cows coded as Jersey.

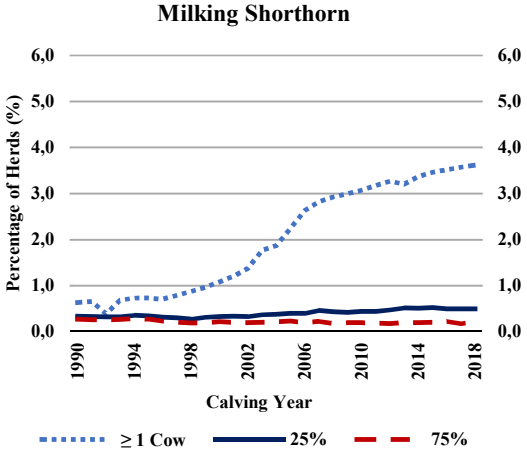

Figure 8. Percentage of herds with cows coded as Milking Shorthorn.

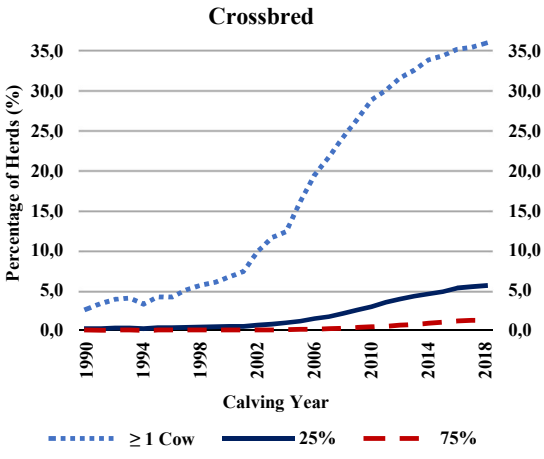

Figure 11. Percentage of herds with cows coded as crossbred.

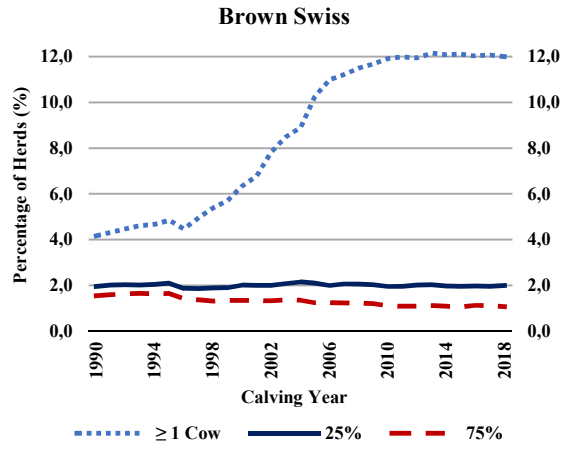

Figure 12. Percentage of herds with cows coded as Brown Swiss.

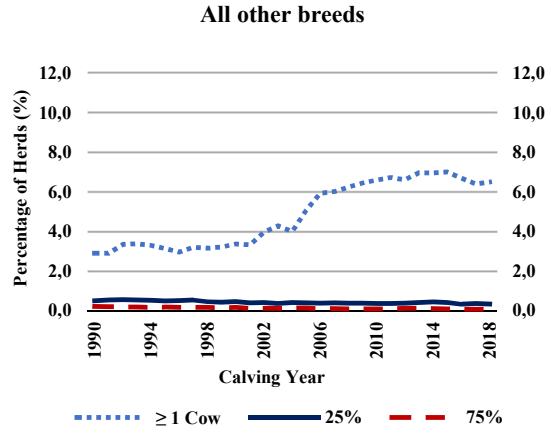

Figure 13. Percentage of herds with cows coded as having any other breed.

Table 3 and Table 4 highlight the number of herds having at least 25% and 75% of an individual breed. Both tables emphasize the dramatic increase of herds with cows coded as crossbreds up until 2013 and the reduction of herds with at least 25% or 75% coded as HO or JE in 2018.

Table 3. The number of herds that have at least 25% and HO, JE and crossbred cows.

	1990	2013	2018
HO herds	35,713	16,734	12,770
JE herds	2,672	1,565	1,282
Crossbred herds	97	812	811

Table 4. The number of herds that have at least 75% HO, JE and crossbred cows.

	1990	2013	2018
HO herds	34,977	15,356	11,604
JE herds	2,323	1,081	859
Crossbred herds	18	143	189

Conclusions

There is a recognizable improvement in data collection and quality since 2006. Data collection by DHI and the illustrations above demonstrate that from 1990–2018 the breed composition of the U.S. dairy herd has changed substantially. Holsteins have decreased moderately, whilst Jerseys and crossbreds have increased considerably. Crossbred cows increased since 1990 (0.1 to 5.3%), as did the number of herds keeping at least one crossbred animal (2.7 to 36.1%). Breed composition on a herd basis provided evidence that the population of Jersey and crossbred herds in the U.S. are increasing.

The majority of the parents of purebred cows were of the same breed (≥95% in most cases). The top three sire breeds of crossbred cows in 2018 were HO, JE and MO. The top three dams (and maternal grand dams) were coded as HO, JE and XX or XD. Remaining sire breeds declined to 9.2% and all other dam breeds declined to 0.9%.

Acknowledgments

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